

CHAMELEON BOOKS

17

A BOOK OF
COMMON INSECTS



A BOOK OF COMMON INSECTS

Written and Illustrated
by
EDMUND SANDARS

GEOFFREY CUMBERLEGE
OXFORD UNIVERSITY PRESS

Oxford University Press, Amen House, London, E.C. 4

GLASGOW NEW YORK TORONTO MELBOURNE WELLINGTON
BOMBAY CALCUTTA MADRAS CAPE TOWN

Geoffrey Cumberlege, Publisher to the University

v

CONTENTS

	Page
INSECTS - - - - -	7
THE WOOD-BORERS : The Stag Beetle - - -	10
THE FOOD-THIEVES . The Large White Butterfly Caterpillar - - - - -	14
THE GRAVE-DIGGERS The Sexton Beetles - -	18
THE BLOOD-SUCKERS . The Gnat - - -	22
THE BEAUTIES : The Red Admiral - - -	26
THE DIVERS : The Water Beetle - - -	30
THE STINGERS . The Wasp - - - - -	34
THE STINKERS : The Cockroach - - - -	38
THE SINGERS . The Green Grasshopper - -	42
FOOD FOR OUR FOOD . The Mayfly - - -	46
THE POISONERS : The House Flies - - -	50
THE GARDENERS . The Bumble Bee - - -	54
THE SPINNERS : The Garden Spider - - -	58
THE DUSTMEN : The Dor Beetle - - -	62
THE INSECT-HUNTERS : The Damsel Flies ' - -	66
THE SERVANT OF MAN : The Honey Bee - -	70
THE HERDSMEN : The Wood Ants - - -	74
CLASSIFICATION - - - - -	78
INDEX - - - - -	80

THE INSECTS

"NASTY, creepy, crawly, creatures—Ugh! Why, the best that can be said for any one of them is that it kills other Insects!" This is how many people think of Insects.

Also many have an instinctive fear and dislike of them. This feeling is un-reasoning, because it is often strongest about those Insects which are perfectly harmless. People who would eat a bun over which they had seen a fly walk might scream if an earwig ran over their hand. Yet a fly-blown bun might give them a serious illness, while the touch of an earwig is completely harmless.

In this book I want to show how interesting it is to learn something about Insects, even if we do not like to touch them.

The first interesting thing is this instinctive feeling of dislike. For its beginnings we must turn to the earliest history of mankind. Primitive Man lived in lands where Insects were larger, more dangerous, and more numerous than they are in England. He was naked, or nearly so, and suffered from their stings and bites. He had a constant fight to save his food from them. Even to get their honey, he had to smoke out and kill the Bees. Our forefathers, like John the Baptist, lived on locusts and wild honey, and it is interesting to trace back to them the inherited instinct which makes us inclined to kill any Insect at sight.

The first great difference between Insects and the back-boned animals (such as ourselves) is that the Insects have their bones on the outside. Our bones are on the inside and our muscles are outside them and attached to them. Insects have no bones inside. The only hard part of them is the outer shell which completely covers them, and it is to this that all their muscles are fastened. The thickness, and therefore the hardness, of this shell varies in different Insects. Thus Caterpillars have thin shells and their bodies feel soft to our touch; those of the Beetles are hard. In all

A Book of Common Insects

Insects the shell is thinner at the joints, which enables them to move when their muscles pull and the flexible joints bend. If you can picture a knight in full armour, without any bones, but with his muscles fastened to the inside of his armour, you will get an idea of the way an Insect is made up.

This description applies to the Lobsters, Crabs, Woodlice, Spiders, and Centipedes, as well as to the Bees, Flies, Beetles and others that we now call Insects. Nowadays we keep the name of Insects for those whose bodies are divided into three parts, and which have one pair of horns, or antennæ, and six legs and no more when they are fully grown.

Insects have also a peculiar way of breathing. They do not breathe through their mouths, but through a number of holes along their flanks which admit the air into a system of tubes spreading all through their bodies.

The six-legged Insects are by far the largest class of animals in the world. There are more than 12,000 different kinds in this country and, though they are all small, there are so many of them that they would, if all balled together, outweigh all the other animals.

All that this little book can do is to tell something of the different trades which they follow, and about the life of one kind of Insect which practises each of these trades.

One thing is common to all Insects. Because of the solidity of their outer cases, and because these cannot grow, an Insect can only grow by crawling out of its case. When doing this it is surrounded by a soft, almost liquid coat that stretches and hardens into a new and larger case. This case-shedding is called moulting.

All Insects moult often during their lives and most of them not only grow larger but, at their last two moults, go through very remarkable changes of shape and character. They all leave the eggs as tiny grubs, called larvae, and remain much the same until the last moult but one. This larval stage is the stage of growth and the only stage in which

The Insects.

Insects eat much. The grubs of different kinds of Insects are also called maggots, gentles, wire-worms, and caterpillars. After this moult most of them enter upon what is called the pupal stage, when they become motionless, take no food, and barely breathe. These pupae (those of Butterflies are often called chrysalids) are resting while the organs of the full grown Insect are forming inside them, and at the last moult the adult, or perfect Insect, crawls out of its pupal skin.

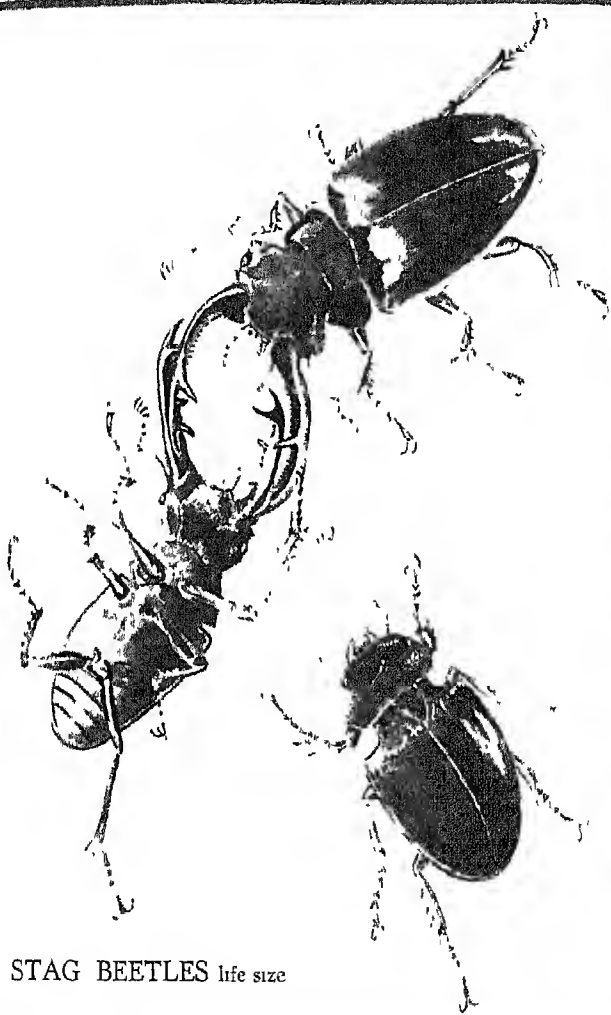
The three creatures, grub, pupa, and adult, are often quite different in almost all respects, including the trade they follow, but they are the same individual, just as are the egg, the chicken, and the cock. Once the adult has come out, there is no more growth. Do not think that little flies will become big ones. Once an Insect has moulted for the last time it will never grow any bigger and, until it has moulted for the last time, it has no wings except in the case of the Mayflies. The adult stage is the mating time—little is eaten, they pair, and the females lay eggs and provide for their families, usually unaided by the males. Although many Insects are harmful, and ought to be destroyed, no inherited dislike of them should rob us of the pleasure and interest to be found in learning about the ways in which their lives are ordered, even if some of them are nasty, creepy, crawly, creatures—Ugh !

THE WOOD BORERS

FIRST place is given here to the Stag Beetle because he is the largest, and one of the handsomest, of our Insects. I say "he" because the female beetle, although she is almost as large, has not the remarkable horns that are the pride of her mate. These horns, which have given him his name and his renown, are really his jaws—the same parts that appear in the female as a small pair of pincers. One of the things about which we know little is the use of these horns. They are not powerful weapons for attack or defence against enemies. Imposing as they look, their gripping power is very slight; they can, at most, feebly hold or scratch, as those of you who have kept Stag Beetles know. When you try to grip a heavy lump of coal with a long pair of fire-tongs, you can understand why this is so, and also why the short jaws of the female can pinch severely if you put a finger tip between them. Neither male nor female will, however, bite us except when we tempt them to do so. Their food consists only of rotting wood, and we are forced to believe that the horns of the male have been developed merely as ornaments, which are probably much admired by the more powerfully jawed, but less handsome, females.

The life of these fine Insects (as Beetles) lasts for about a month in summer. At the end of that time, the females lay their eggs in the decaying wood of a tree trunk (usually an oak) and die. The eggs quickly hatch and a tiny grub comes out. This, like the grubs of most Beetles, has a hard chewing mouth, three pairs of small legs and a long wormlike body. As the grub's food is the rotting wood in which it finds itself, it has not got to look for food, but merely to eat its way into the wood and to go on doing so throughout its grub life.

One thing is noticed about all Wood Borers, and that is their long life. Although no time is wasted in search of food, there is so little nourishment in wood that it takes them a



STAG BEETLES life size

A Book of Common Insects

long time to grow up. The Stag Beetle grub takes five, or even six, years to grow to its full size. All of this time (and during the month or so that it spends as a motionless pupa) it is out of our sight. During the grub life it makes its way down the tree to the roots and continues feeding there. When it is ready to change into a pupa, it comes out underground and there builds itself an earthen case, cemented with its saliva, in which it passes the pupal stage. When the complete adult Beetle leaves the pupal skin it will wait for some time (sometimes a further month or more) while its outer skin hardens and takes on the rich black-brown colour. Then the creature crawls to the surface of the ground and flies or walks off to begin its search for a mate.

Like most Beetles, the Stag Beetles have large hind wings and they fly swiftly and well, though they do not fly often. When they do, it is usually only at dusk or at night, so that we do not often see them in flight. When Beetles get ready to fly, we see that the difference between them and other Insects is that their fore wings are really not wings at all, but cases to protect the hind wings. These cases are hard, brittle, and stiff, and they lie closely over the hind wings and the body, meeting in a straight line along the back. When the Beetle is about to fly, you will see that the wing-cases open and the larger hind wings, which are thin and transparent like those of a Fly, spread out and drive the Beetle through the air by their beating. The wing-cases do not beat. They remain open and stiffly outstretched like the wings of an aeroplane, and they do much the same work. You will see this process best by watching the little Beetle we know as a Ladybird after you have told her the old tarradiddle :

Ladybird, Ladybird, fly away home.

Your house is on fire. Your children will burn !

There are many other Wood Borers among the Insects. Some of them do us much harm because, unlike the Stag Beetle, they do not eat their way through rotten wood, but

The Wood Borers

through sound, healthy timber, or through wood already made into planks, beams, or furniture. Among the many wood-boring Beetles is the Death Watch Beetle which has totally destroyed so many of the great timber roofs of our churches, and the Furniture Beetle which bores the small holes we see in chairs and tables, and in plywood and the sapwood of oak beams. The wood-boring trade is carried on in growing timber by the nasty-smelling caterpillars of the Goat Moth, and of many other Moths. The Horntails, which are relations of the Wasps, work in cut timber.

Many of the wood-boring caterpillars that are going to become Moths go through their pupal stages inside the wood. As, unlike the Beetles or Horntails, their adults have no biting jaws, the larvae have to arrange some way by which the adults can get to the surface and out of the wood. Their devices are most ingenious and interesting. Thus the larva of the Clear Wing Moth eats its way from deep in its tree to within a thin layer of the surface of the bark. Then it turns about and goes into the wood again to pupate, carefully turning head outwards before doing so. The pupa has enough power of movement to wiggle its way to the thin door and push it open, so that when the Moth comes out it is free. When this Moth does come out you will be inclined to mistake it for a huge Wasp or Hornet. It is really completely defenceless, but it has gained safety from its likeness to the stinging Insects, for this likeness frightens other creatures as well as ourselves.

THE FOOD THIEVES

OF all the trades practised by Insects, that of the Food-thief is the commonest and most widespread. We live almost wholly upon plants or upon animals that eat plants. Bread, sugar, vegetables, oil, fruits, nuts and salads, tea, coffee, cocoa, wine and beer, are purely plant products, and all the animals and birds that we eat are almost wholly eaters of plants. For ourselves therefore, and for our cattle, we cultivate crops of various plants to provide food. Unfortunately for us, the greater part of the Insects have the same need—they also live upon plants, their roots, their stems, their leaves, their buds, and their fruits. There is hardly any plant, or any part of a plant, that is not the favourite food of some Insect.

I have chosen the Large White Butterfly as the example of the Food-thieves because its Caterpillar is one of the most harmful Insects we have. The reason for this is interesting. On the shingles of our sea coasts there grows a bitter, meagre, little plant called the sea kale. From it alone, Man, working over thousands of years, has grown almost all our vegetables. The cabbage, the cauliflower, the Brussels sprout, the turnip, the swede, and the mangel-worzel are all descendants of the wild sea kale. Most plant-eating Insects eat only one plant or one family of plants, and among those chosen by the White Butterflies for their food happened to be the seakale. When, therefore, Man covered the land with the vegetables derived from it, he also spread a giant feast for White (or Cabbage) Butterfly larvae. Insects are quick to take advantage of free meals. The result is that these Whites have become our commonest Butterflies, as well as those which, because of their colour, are the easiest of all for us to see in flight.

At any time of year from the end of April to September you may see the Large Whites laying their eggs on the cab-

A Book of Common Insects

bages. They are laid in batches of as many as a hundred together and may be on either side of the leaf. They are small, yellow, long things which stand up side by side, like a lot of bottles on a shelf.

In a week or two they hatch and out come the small grubs or caterpillars, in shape and colour much as they will be when fully grown. The first act of the young caterpillars is to eat the eggshell from which they came. Then they spin a carpet under their feet upon which they stay feeding on the cabbage leaf. They stay together, side by side, feeding in company, and they have one very odd habit. They all stop feeding at the same moment, and all start again together with the precision of drilled troops, though we do not know by whom, or how, their orders are given. As they grow larger, so do the holes they eat in our cabbages and the nasty smell grows stronger. After four moults, they no longer spin a carpet and, when fully grown, which is in about a month, they separate and take up a position in which to become pupae.

When these pupae, from eggs laid in the spring, become Butterflies, the Butterflies live about a month, lay eggs, and die. These summer eggs become Butterflies in their turn, which lay eggs and die. In this way, two or three generations (or broods) appear in a year, and the last brood passes the winter in the pupal stage. In spring or summer the pupae are found on the cabbages. In autumn they lie under a ledge or along a paling, not far from the cabbages.

Not only have we many of them always here, but others, flying in great clouds over the sea, come to join them from abroad in certain years to take advantage of our unwilling hospitality and ravage our vegetable gardens and root crops.

These creatures (like most of the Food-thieves) harm us only in the growing (grub) stage. The adult Butterfly has no biting mouth. It only sips nectar from the flowers, and is helpful as a Gardener. It is among those mentioned on

The Food Thieves

page 54, and it then fertilizes the very plants it ravaged in its youth

So great is the number of the Food-thieves that if we were not protected from them by the creatures that eat them (particularly by other insects and the birds) we should be starved off the face of the earth in a very short time. All the Butterfly Caterpillars are plant eaters, so the only ones that are not Food-thieves are those which choose for their food weeds, or such plants as are useless to us or our beasts. The same is true of most of the thousands of kinds of Moth Caterpillars, and of the grubs of the still more numerous Beetles. The Bees do no harm. Wasps destroy a good deal of fruit, but the Ants are both thieves themselves and receivers of the goods stolen by the Green-Fly which they protect and milk. The Sawflies (also as grubs) are food thieves, but most of the two-winged Flies are innocent of this crime. Among the worst offenders are the very many kinds of Plant Bugs, and they offend throughout their lives. These last Insects do not gnaw the plants on which they feed, but pierce the outer skin of leaves and stems and suck the sap through their sharp-pointed trunks.

The Green-Fly is the worst of these, because, although each one of them is very small, they are in such gigantic numbers

THE GRAVE-DIGGERS

HAVE you ever wondered why it is that you so seldom see a dead mouse or a dead bird in your country walks? Almost all the smallest creatures have large families and every year as many of them die as are born. A pair of Toads may produce several thousand little Toads every year and all but two of these will probably die during the year, yet how often do you see a dead Toad? There are many different reasons why their bodies do not lie about on the ground for long. The Birds and Beasts of Prey that kill them, also eat them. Then there are also many animals, such as Pigs or Hedgehogs, and many birds, such as the Crows, which eat up any dead body they find on the ground. There are the Insects that I call the Dustmen (see page 62) which eat up dead bodies, or lay their eggs upon them so that their grubs can eat them when hatched.

But there is one family of Beetles, known as the Sexton Beetles, which make it their trade to bury all small corpses. These are the Grave Diggers. As soon as these Beetles smell any dead creature, they spread their wings and fly to the spot. After crawling round about to prospect, they set to work to dig themselves into the ground under their find. They are strong and tireless diggers, and, as they get under the body, digging with their fore legs and throwing the soil out behind them with their hind legs, they feel the weight of the body upon their backs as it sinks down into the hole they are making. In an astonishingly short time, if all goes well, the body sinks into the ground and is wholly covered by the loose earth dug out from underneath it. The work will go on until the body has sunk as much as a foot underground.

It is necessary to say "If all goes well" because the Beetles have many disappointments. The body they have found may be too big for them to bury. The ground under it may be so hard, or so stony, that digging is beyond their



SEXTON BEETLES (13)

A Book of Common Insects

powers. In this case, the Beetles, after trying for some time, are driven to give up the job and leave the place in search of a more promising task. Many difficulties, however, they can overcome. If softer soil is found at a very short distance, they will hoist and jerk the body towards the soft spot, after which all will be easy again. Another common trouble arises from the roots of plants, the stems of ground ivy, or other rope-like threads of vegetation, which prevent the descent of the body, and hold it up. This is soon detected by the Beetles because they no longer feel the weight on their backs, which is for them the sure sign that all is going well. Something is hindering the work and this must be found and removed. They go carefully over the whole body and, with their strong jaws, gnaw through any fibre that touches it. Experiments have shown that in this way they will cut through any string by which their prize is held up, and if it is fastened by a wire which they cannot cut, they will bite through the animal's paw to which the wire is fastened.

Why do these Grave-diggers bury small corpses? It is certainly not to tidy the countryside or to make it pleasanter or healthier for us. Nor is it mainly for their own benefit. It is to give food and a safe nursery to their children. It has been noticed that although they assemble in large numbers and all (males and females) work together at the burial, the body belongs to a single pair only. When the burial is over all the workers except one pair come up to the surface and fly off to look for other duties. The owners, which stay behind, set to work to prepare the body, skinning it and making it ready for their future grubs. Then the eggs are laid on it and the couple come up to the surface of the ground and go off somewhere else to resume their tasks of digging to help others to provide a nursery for their young. As the summer advances they sometimes stay in the ground with a body and do not come to the surface again until the

The Grave Diggers

autumn, when, tired of their work, their mates, and their lives, they quarrel, fight, kill, and eat each other !

Then grubs, hatched from the eggs with such a plentiful store of food provided for them, grow to their full size in a fortnight or so, when they go down still deeper in the ground to pupate. As adult Beetles, they spend a short autumn season above ground. When it gets cold, they dig themselves in for the winter, coming out again in the spring to carry on the trade of Grave-diggers in their turn.

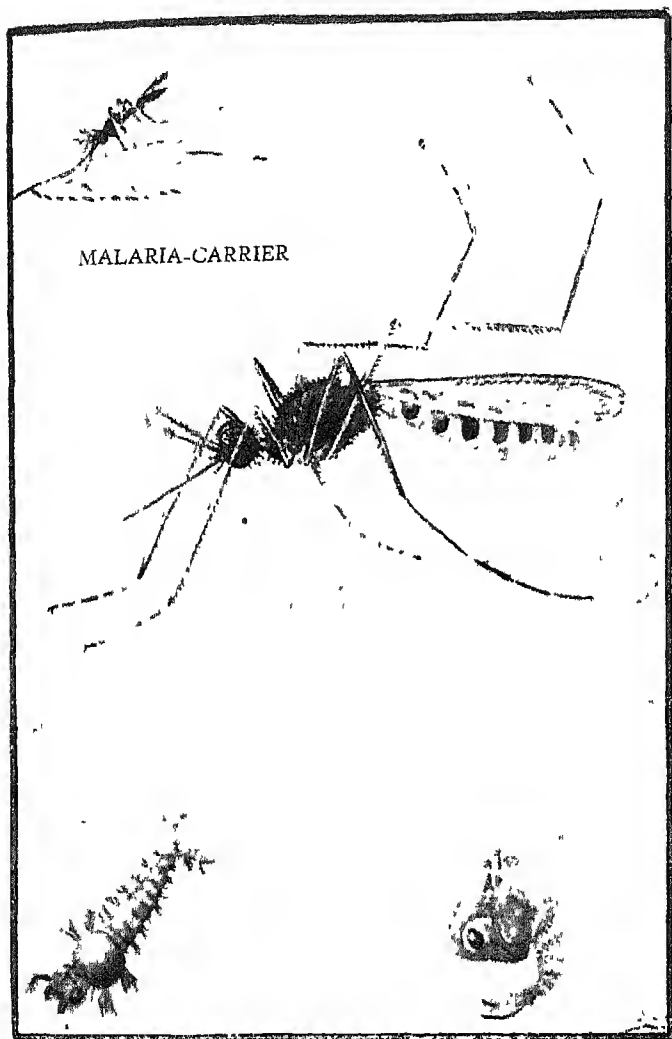
This single family of Sexton Beetles are the only Insects that bury animal bodies, and their services are at the disposal of any corpse not too large for them. They will bury small quadrupeds, reptiles, frogs, or birds. Even fish, or a bit of decaying butcher's meat, they will bury. All that they ask of it is that it should smell.

THE BLOOD-SUCKERS

LUCKILY for us, there are not many kinds of Insects which suck our blood, but those that do are often in great numbers. The common Gnat makes life almost unbearable in some parts of the world at certain seasons. Gnats and Mosquitos are two names for the same Insects, although some people speak as if Mosquitos were the blood-suckers, while the Gnats were quite harmless. This is not so, although there are a great many Insects which are very like Gnats to look at, but which do us no harm.

Gnats lay their eggs in water and the young (larvae and pupae) live there until they are fully grown. The mother Gnat chooses the water for her young very carefully. It must not be pure, for it is upon the minute animal and vegetable substances floating in it that the young must live. Dirty stagnant water is what she looks for, and that is why draining the marshes does more to get rid of Gnats than anything else. But the Gnat does not need a marsh. A very small pool of water will do and, in this country, probably more Gnats are bred in the tubs which collect the rain water from our roofs than anywhere else. Here at any time during the warm weather the big-headed larvae may be seen resting near the top of the water, breathing the air through small tubes which stick out near their tails. They get their food in an odd way. On their heads they have a pair of feelers which they keep waving round and round in such a way as to keep up a steady flow of water which passes their mouths, and from the water they seize and swallow the minute animal and vegetable particles contained in it.

When fully grown they change into pupae. The Gnat pupa is unlike that of most insects because it is active and able to swim about in the water. It also has a big head and breathes at the surface through tubes in the head, which lies uppermost in the water. Its shape is shrimp-like and it



COMMON GNAT, LARVA AND PUPA, $\times 6$

A Book of Common Insects

swims with the help of two fan-shaped tails. When the adult Gnat is ready to fly, it breaks the skin of the pupa at the water surface and takes to the air.

Gnats are two-winged Flies, the hind pair of wings, which most other Insects have, being replaced by a tiny pair of "balancers" You will see these balancers clearly in the Daddy-long-legs, which is very like a huge Gnat but without the Gnat's skin-piercing mouth, or its blood-sucking habits. The Gnat hides them when at rest because its wings are held flat along its body. We do not know just what they do, but they are in some way needed for flight. Without them flight is impossible for any two-winged Fly.

When this adult stage is reached, we find an important difference between the sexes. You can tell them apart because the antennae of the males are very feathery, while those of the females have only a few branching hairs, as shown in my sketch. But the great distinction so far as we are concerned is in their habits. The males eat little or nothing, at most sucking a little moisture from plants or dew drops. They fly, with a curious dancing movement, up and down in the air, often in large numbers, until a female passes with whom they can mate, and, shortly afterwards, they die. The females, however, are very different. They need to suck the blood of some warm-blooded animal and, as we are both thin-skinned and warm-blooded, they find us most suitable. Flying, chiefly at dusk or by night, with the buzzing which marks the flight of most Insects, and which in their case has a high note sounding like the word "Ping," they settle softly and silently upon our skin, thrust their long, needle-like beaks into us, and drink their fill of our blood.

Their beaks are well built for the purpose, and are made up of an outer tube or sheath, an inner sucking tube, and no fewer than four sharp piercing needles. The reason why the Gnat-bite is so irritating is that the Insect, after piercing its hole, fills the wound with a liquid to make the blood flow

The Blood-suckers

easily. This liquid acts as a poison and makes the place swell and itch for some time. Without it the bite would not be felt at all.

But the greatest danger from the Blood-suckers does not come from their own poison. It comes from poison in the blood of some other person or animal they have already bitten which may be left behind in the wound. In other words, they carry blood from one victim to another, and, in this way, spread diseases. One kind of Gnat is wholly responsible for the spread of Malaria. You can tell this kind from the Common Gnat because the Malaria carrier does not cock up its hind legs when resting as the Common Gnat does.

I started by saying that not many kinds of Insects are Blood-suckers. There is one kind of Bug, and there are many kinds of Fleas, one of which prefers us to any other victim. All the others are two-winged Flies, and with very few exceptions it is only the females that bite. Quite a number of the Horse Flies or Cattle Flies will bite us, but usually they prefer the horses and cattle. The most troublesome and irritating of all, perhaps, are the smallest—the Sand Flies and the Midges. There is only one kind of Fly of which the males as well as the females suck our blood. This is a small grey Fly called the Stable Fly—a creature very like the common House Fly, but recognizable by its stiff piercing, needle-like snout which sticks straight out in front of its head. It is responsible for the spread of much serious illness.

THE BEAUTIES

THERE are not many Insects which are lovely to look at, but, of all the beauties of this world, few are more exquisite than some of the Butterflies. In thinking of them we do not stop to ask ourselves whether they are helpful to our farmers or not. We are content to enjoy their glory of colour, their grace of airy movement, and their evident pleasure in things which also bring happiness to us—the radiance of flowers and the welcome warmth of the sunshine.

Few of them are more beautiful than the Red Admiral. The choice of its name is one of the strange accidents of word-making. The first writers who gave the Butterflies special names called it the Red Admirable, and it was only when that name seemed too long or too clumsy for common use that it got shortened into its present form. On the lips of a people whose pride is in their Navy, it still bears its old meaning.

The Red Admiral may be seen in our flower gardens all through the warmer months from the end of May until about the middle of October, and during that time two broods are produced. Those which we see in June and July lay eggs which give us a second generation in August and September and, sometimes, even a third brood comes out of their chrysalids by the end of September. The broods overlap each other so that our flowers in summer are rarely left without some of these magnificent visitors.

This Butterfly has an added claim to its seafaring name. It is among the very small number of our common Butterflies which cross the sea to come here. If they did not, we should not have any Red Admirals, for it is only in unusually mild winters that one or two survive in some sheltered spot. Apart from these few, and their descendants, every Red Admiral seen in this country has either flown to us from the warmer parts of the continent, or been born from parents

RED ADMIRAL
(x 3)



Larva and Chrysalis
life size

A Book of Common Insects

which crossed the sea earlier in the same year. There are years when great numbers arrive and other years when very few come. As they breed here once or twice during the summer, there are many more to be seen towards autumn than in May and June when they first begin to cross the Channel to come to us. Once here they are not content to settle down near the coasts on which they landed, but they spread all over the country, even up to the Northern Isles.

Although we do not think of their usefulness, or expect more from them than the pleasure of watching them, the Red Admirals are among the few Butterflies which are wholly useful. Not only do they help to fertilize our flowers—all Butterflies do this—but the only plant upon which their caterpillars feed is a useless weed, the stinging nettle. Their eggs are laid upon the nettles and when the tiny larvae hatch out, in a week or so, they feed on these tiresome plants all through their lives as caterpillars. It takes them about a month to reach full growth, and then they hang themselves up under a nettle leaf for about a fortnight in the motionless sleep of the pupal stage. From this the perfect Butterfly comes out at last in all its splendour.

The Butterflies flit from flower to flower, sucking the nectar from their blooms and, while doing so, they carry the pollen from one flower to another and so enable the seeds to ripen for the following year. Then, after a month or two of life, having rejoiced in the rays of the sun and reflected them back to our delighted eyes from the superb patterns of the many-coloured scales on their wings, they lay their eggs and die. When the cold of autumn comes, they perish, whatever stage they may have reached—egg, larva, pupa, or adult Butterfly—except in the rare cases I have mentioned; and that leaves us without Red Admirals until the next year's travellers come from over the sea to cheer us.

The Insects which are so lovely to look at that we think of their beauty rather than of anything that they do, are those

The Beauties

that I have called the Beauties. They are very few. We have only 60 kinds of Butterflies and not all of these are handsome enough to be in this group, though many are. The Blues reflect the cloudless midday sky and, when their wings are closed, show many minute spots like eyes peeping from an exquisite grey. The Fritillaries, with their tawny glow above and their silver mirrors beneath the wings, and the Orange Tip, with his underside clad in green lace, are amongst nature's most superb creatures. A few of the day-flying Moths are beautiful. There are a number of finely coloured Beetles, of which the useful Ladybird will occur to you at once. The Dragonflies are handsomely coloured though we seldom get a chance to see them well. We must admire the yellow and black livery of the Wasps, too, even though our fear of their stings prevents us from first thinking of them as beauties. There is a lovely delicacy about the Mayfly and the Lacewings, and a fat cheerfulness about the Bumble Bees, which make us glad when we learn how useful they are, but they do not belong among the Beauties because their good deeds are more important to us than their good looks.

THE DIVERS

THERE are a great many Insects which spend their childhood under water, in ponds or streams, and leave the water for the dry land when they become full grown. Those which I am going to write about here live their whole lives almost entirely under water. The great Diver or Water Beetle, shown, life size, in my sketch, is the largest of a numerous family of Beetles which, both as larvae and as adults, are fierce flesh-eaters, preying upon any form of water life which they can master, insect, larva, snail, frog, toad, newt, or fish. Their eggs are laid by the mother-beetle under the water in the stems of water weeds, and the larvae which hatch from them actively hunt the ponds in which they are born for tadpoles and all other living creatures. They have no gills and they breathe air by means of air holes at the tail end. Thus when they come to the surface to breathe, they appear to hang from the surface-film of the water by the two thin tails, which they spread out along the top of the water, one on each side of the breathing hole. Most of their time is spent in this position, though they dive at once in pursuit of any prey they see in the water below them, or to avoid any danger that threatens them from above. When they have reached their full size in this form, they crawl out of the water in the autumn to undergo their pupal stage in the moss or some hole in the bank, just out of the water. In this hiding-place the adult Beetles remain for some time until they are fully coloured and hardened, or until they feel the warmth of spring. Then they crawl back to the water.

The two sexes differ in colour, the males being black and the females brown. The males have also odd-shaped forelegs which serve to catch and grip the females. Both sexes have the two hinder pairs of legs flattened and hairy, so as to make an oar-like blade with which to row their bodies



WATER BEETLES
Life size Male, Female and Larva

A Book of Common Insects

through the water. These legs go forwards edgewise through the water and then turn their flat faces to the water to row. It is very like what we call "feathering" with an oar.

Though these great Beetles live almost wholly under water, they must breathe air like all other adult Insects. To do this they are formed in an unusual and remarkable way. Their wing-cases fit tightly together down the middle of the back and form a curved dome over their flat backs, so as to leave space for a large bubble of air inside. This bubble is the air supply upon which the Beetle draws for its breathing when under water. When the supply has to be renewed, the Beetle comes to the surface and, putting up its tail end, takes in fresh air.

This position at the surface (shown in the case of the male in the sketch) is one which the Beetles commonly take up until they see some insect, or other prey, in the water, when a sudden dive sends the Beetle in pursuit. They have powerful biting jaws and can kill and eat creatures much larger than themselves, such as frogs and fish. Handsome and interesting as these Beetles are, it is, therefore, impossible to keep them in an aquarium unless they are to be in it alone with such creatures as are provided for their food. If the larvae are kept, they will eat each other as soon as they get short of other food. If the Beetles are kept, the aquarium must be covered with a glass or wire covering, because their wings are well developed and they will fly off (usually at night) in search of other waters. In the autumn they come ashore and lie up for the winter months in some mossy hiding place.

These flesh-eating Water Beetles are not the only Divers. There is also a family of Beetles which, as adults, are plant eaters, harmless to all other creatures. These can therefore safely be admitted to any aquarium. You can tell them from their fierce flesh-eating relations by their different way

The Divers

of taking in fresh air. In their case the air is drawn in to the supply-chamber under the wing cases from the forward end, at the Beetle's shoulders, so that when taking in fresh air they are head-upwards in the water. They also fly to fresh waters to find fresh pastures and mates. The larvae of these plant-eating Beetles are much less active and, though they do eat animal food, they have to content themselves with water snails.

Other Divers, which live as adults under the surface of fresh waters, are to be found among the Bugs. These Insects have stiff piercing and sucking beaks, with which they feed on the juices of plants or of Insects or other animals. Several of these Water Bugs are able to hurt us quite severely with their beaks.

There is one single Diver among the Spiders that spends its life under water and builds a diving bell to ensure its supply of air. Spiders, like Insects, are air breathers and the way this creature gets its supply of air is unique. It spins a flat sheet of silk under the water and then brings down bubbles of air, held between its legs, and lets them go under the silken sheet which thus holds a store of air in which the spider lives throughout its life. From this strange home the Spider goes out to catch its prey in the water and to renew its store of air when needed.

Other Beetles and Bugs skate or row themselves about on the surface of fresh waters, as you may see on any village pond, but these are rarely true divers as they do not often go beneath the surface.

Such other Insects as are to be seen under water are either larvae which will leave the water when they are fully grown, or else, like some of the Dragonflies, they are merely in water for an instant for the purpose of laying their eggs.

THE STINGERS

"It looked so pretty when it walked over my hand, but, Oh dear! when it sat down!" This description of a Wasp by a little girl appeared in the pages of *Punch* many years ago, and it tells the experience of many of us. The common Wasps are handsome and intelligent insects and, although they do a lot of damage by eating our ripe fruit, this is more than offset by the good they do us by feeding their grubs on other Insects. But they have a weapon—the sting—which they use to defend themselves or the nest, and which, when used upon us, causes an acute, burning pain and swelling. The Wasp's sting may even be dangerous to people who are not in good health.

The female (or queen) Wasp is born late in the summer or autumn. She is then mated with a male from her own, or another, nest and he dies immediately after their wedding flight. The queens alone live through the winter. Each one finds a hiding place, where, hanging by her jaws to a curtain inside our houses, or in some hole or cranny in a tree-trunk or elsewhere out of doors, she sleeps through the winter months. As soon as spring comes (sometimes as early as March) she wakes up and, after refreshing herself with the nectar from some blossoms, she begins to build herself a nest. She lays a few eggs, and, all by herself, she brings up her first few children, feeding them with dead Insects. These children are all much smaller than herself and of the type known as "workers". As soon as the first few of her worker children are fully grown up, they take over all the duties that their mother has performed alone until then, leaving her to stay in the nest and devote her whole time to laying eggs. Bees make their nests of wax and provide pollen and honey for their brood. The Wasps build theirs of paper, and the young grubs are fed upon flies and other insects. In this way, although Wasps go to the flowers for their own



WORKER



QUEEN

(life size)



QUEEN WASP

(x 5)

A Book of Common Insects

food, they visit them far less often than do any of the Bees and are, therefore, not nearly so useful to us as Gardeners. On the other hand, no Bee helps us in the great fight against other insects, whereas the Wasps get all their substance while they are growing to their full size from the bodies of insects which are killed, chewed up, and carried to the nest by the Queen Wasp, or, later, by their elder worker sisters.

A Queen Wasp lays a great many eggs, and at the end of the summer there may be hundreds of Wasps alive and working in the nest, which, therefore, has to be large. It often becomes as large as a football. Some Wasps build their paper nests in trees, but the nest of the common Wasp is built underground, usually in a bank or hedge-bottom, and the large hollow needed to hold it is dug by the Wasps mouthful by mouthful. Each piece of earth (including stones larger than the Wasps themselves) is taken out and dropped well clear of the nest. The paper of which the nest itself is made is composed of wood, gnawed off the surface of any weathered post or plank and mixed with the Wasps' saliva. With this paper a structure rather like a Hive Bee's comb is built. Each paper cell is six sided, but, in the Wasp's nest, the comb lies flat and the cells all hang downwards from its platform, so that their entrances are open to Wasps walking on the next platform below. The whole is enclosed in a paper envelope, and when the nest has to be made bigger, old work that is in the way is chewed up into paper and used again. There are, of course, no honey-cells as no honey is made or stored.

The whole colony lasts only for one year. Big, stingless males and the queens for next year are born early in autumn, and as soon as the workers feel that the supply of insects for the young grubs is beginning to run short, a strange thing happens. The workers drag out of the nest all the remaining wasp-grubs, which until that moment they have laboured to feed, clean, and cherish, and throw them out to die of cold and

The Stingers

starvation. Then the workers themselves and all the males perish, and only the widowed queens are left. They hide for the winter, and next year each one founds her own nest.

So if you want to kill off Wasps, the time to do it is in the spring, when the queens are about, for every queen killed means a whole Wasp's nest destroyed. The way to kill them is to carry a paintbrush and a small bottle of petrol about with you. Dip the brush in petrol and give one touch to the Wasp which dies instantly.

Only Wasps and Bees, and their near relations, have stings. As well as the social Wasps and Bees there are a number of solitary members of the same group which have stings. They rarely use them on us. Often, instead of being weapons of defence, they are used to kill or paralyze the insects which the Wasps store up as food for their young. Some of the Ants have stings, but no stings are as painful as those of the Hive Bees and of the various Wasps, particularly those large Wasps that we call Hornets. Luckily they are rare, and, unless we go out of our way to attack their nests, they are said not to be so ready to "sit down" on us as the common Wasps are.

At any rate, the Stingers do not carry diseases on their stings from one person to another, as the Blood-suckers do with their mouths.

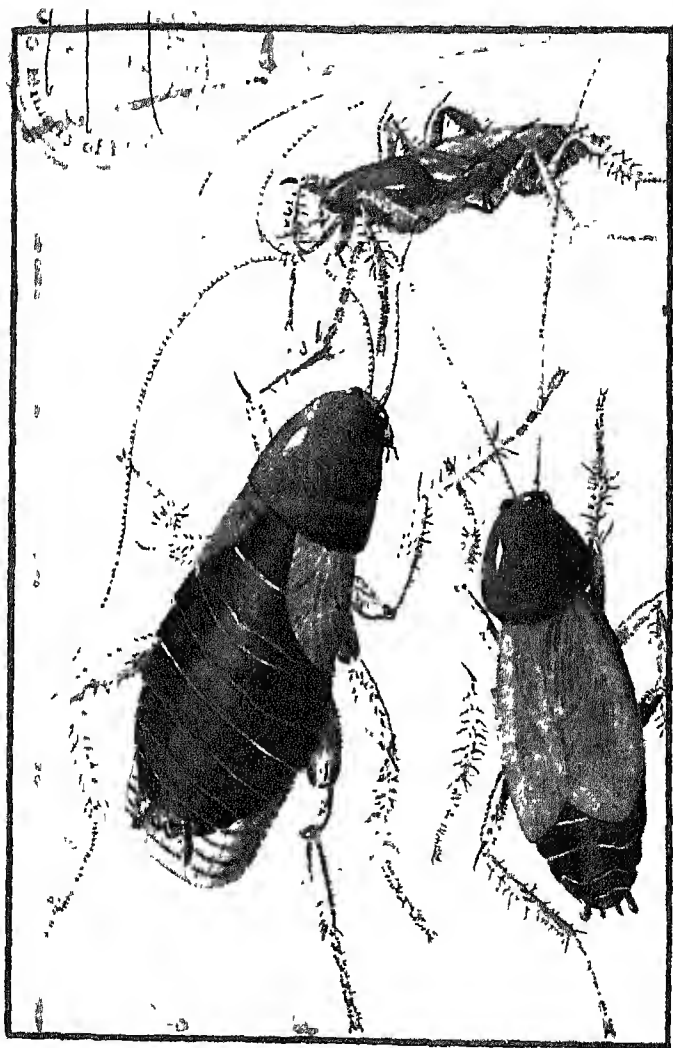
THE STINKERS

WHEN you first meet a Cockroach, you will certainly take a dislike to it at sight, and this dislike will probably last all your life. You will also call Cockroaches Black Beetles, and you will probably go on doing so long after you have been told that it is wrong because they are not Beetles at all.

The difference between Beetles and Cockroaches is this.

Beetles, when they hatch from their eggs, are grubs or maggots and, when they have grown to their full size, they turn into motionless pupae. Then they change into full-grown Beetles. When fully grown, their fore wings are hard cases which cover their bodies, and, if they have any flying wings at all, these are the two hind wings which lie folded up under these cases when the beetle is not flying. Now the Cockroach goes through no such remarkable changes of form. It hatches from the egg as a small Cockroach, and a Cockroach it remains until its death. It moults its skin often, growing bigger, blacker, and smellier with each moult, and it gradually develops the organs which show that it is full-grown, particularly the wings. The males have two pairs of wings, both of which are used in flight, and although the fore wings are rather more leathery than the hind, and cover them when not in use, they are nothing like the hard brittle cases of the Beetles. The wings of the females are very small and not used at all.

The reason why I have labelled the Cockroaches as Stinkers is because they have one way of defending themselves against their enemies. They make a nasty smell. This smell comes from two openings under their bodies, and their smell will pervade a whole house and make it disgusting if they are allowed to collect in large numbers. They are not really natives of this country, but belong to warmer lands, and they have been brought here in ships and have spread over the country. They live only in places warmed by Man :



COCKROACHES ($\times 3$) Female with eggs, Male, and Larva (above)

A Book of Common Insects

our ships, our greenhouses, and our dwellings. They have chewing mouths and will eat almost anything, animal or vegetable, provisions, paper, leather, or dead insects. They are particularly attracted to anything sweet or starchy, and are therefore most numerous in our kitchens and larders. If one Cockroach is killed, others will carry off the body and eat it.

They are lovers of darkness and seldom venture into the light. The way to see them best is to go into the kitchen any time after dark and suddenly to switch on a bright light. Then, in any house where there are Black Beetles, these repulsive insects will be seen scurrying away to get back into the darkness. They run with great speed, and are soon out of sight. They cannot climb up a steep smooth glass, or china surface, as so many Insects can, and they are easily tempted to go down such a slope to get at food or drink which pleases them. An open pie dish with some beer and sugar in it makes a very useful trap. If a stick is placed leaning against the rim to act as a ladder, they will be found drowned in the morning.

Once they are at home in a house it is hard to get rid of them. The only sure defence against Black Beetles is cleanliness: no unstopped crannies in which they can hide, no food lying unprotected, no crumbs on the floor; nothing for them to eat.

If you look at them closely, you will see that their bodies are much flattened and that their heads are tucked away under the large shield which forms the neck. They certainly do not obey the order to "Look upwards and not down!" for their faces are wholly on the underside. They rarely fly and never in the daytime, so that few people have ever seen a flying Cockroach. Although the stink of the Cockroach is supposed to disgust those creatures which would otherwise eat it, it is not always successful. Put a Hedgehog in the kitchen for a few nights and it will do fine work. Cats kill, but do not usually eat, them. We must

The Stinkers

remember that they foul, and so destroy, much more of our food than they actually eat.

Another very numerous group of Insects which are provided with what are called stink-glands, and which rely upon their disagreeable smell to protect them against their enemies, are the Bugs. These creatures usually suck the sap of plants through a stiff piercing trunk that they drive into the outer skin of the plant. A few, such as the infamous Bed Bug, are, in the same way, piercers of our skins, and suckers of our blood. Almost all the Bugs have a most sickening smell, which, like that of the Cockroach, is produced from glands under the body. There are also a number of true, hard-cased Beetles which trust to their smell to act as a defensive weapon, and in the case of the Bombardier Beetle, the insect raises its tail and discharges a small explosion of poison gas in the face of any pursuer. Most of our Ants are stingless, but they also discharge acid fumes upon their enemies as a weapon of attack or defence. These, however, we can hardly class among the Stinkers, for though they irritate our eyes or skin, they do not make a nasty smell.

THE SINGERS

You must not take this title too strictly, or let your mind stray to the melody of the Blackbird, or the sweet voices of the church choir. No Insect makes any sound with its mouth, and no sound made by an Insect has the variety or the tunefulness which we connect in our minds with the word "song".

Yet when you sit out of doors on a really hot summer's day in the haymaking time, and hear the great chorus of chirping, twittering, buzzing, and humming sounds made by the Grasshoppers, Crickets, Bees, Wasps and Flies, you will soon see why the word "song" has been applied to this Insect chorus.

The Insects were the first of all animals to make any sound at all, and the sounds that some of them make are clearly made to give pleasure to themselves or each other. Such, then, is the excuse for speaking of a few insects as Singers.

I have chosen as an example the Long-horned Green Grasshopper, in the picture opposite. The male is in flight and the female below. The group of Insects to which they belong is among those that change very little from the time they leave the egg to the time when they are fully grown. The minute Grasshopper which hatches from the egg, although without wings, looks like a Grasshopper, and even the growth of the wings is so gradual that they hardly seem to change its appearance until they open in flight after the last moult. The wings come to their full size like buds upon the growing Insect's shoulders—slightly larger after each moult.

When they are fully grown the Grasshoppers do not fly much unless alarmed by your footsteps, or when seeking a mate. Their progress is made by a series of giant bounds, for which their long hind legs are built. When they do fly, we see that the two pairs of wings are different. The fore wings are straight, narrow, long and leathery, and the hind



GREEN
GRASSHOPPERS ($\times 1\frac{1}{2}$)

A Book of Common Insects

wings are broad, thin, and transparent, and folded fan-wise under the protection of the fore wings when they are at rest. When the Insect is ready to fly, it makes a leap into the air and the wings then open out.

Their mouths are built to bite and, although they never bite us in anger (or even in self-defence), you will be painfully surprised at the pinch (drawing blood) which you will get if you put the tip of your finger to a Grasshopper's mouth, just to see if it bites.

The cheerful song of the Green Grasshopper is sung only by the male, and it seldom stops while the sun shines. The passing shadow of a cloud brings silence to the meadow, which till then has been so full of sound. As we have seen, the sound is not made with the mouth, which is without breath for an Insect breathes through holes in its sides. It is made by rubbing together two parts of the singer's hard shell. He is a fiddler, not a vocalist. In the Green Grasshopper the instrument is at the base of the two fore wings, where a small file on the one rubs the ribs of the other. He rubs his shoulder blades together, and his joyful ditty rings out. The females have no such instrument.

It would be of little use to sing if he had no audience, so we find both sexes provided with ears, placed below the knees of the fore legs! These Grasshoppers are mostly hunters, which prey upon other Insects.

We have another quite distinct family of Singers, called the Short-horned Grasshoppers, which are oddly like, and oddly unlike, the Long-horns. They are wholly vegetarian. Their females have not the long sword-like weapon with which those of the Long-horns lay their eggs. As in the case of the Long-horns, only the male Short-horn Grasshoppers sing, and they sing with the same energy as the Long-horns, but their musical instruments are a series of studs all along the inside of the big jumping thighs with which they rub the raised ribs on the outside of their fore wings. Their "ears",

The Singers

and those of their wives, are at each side of their bodies, just behind the hips of the hind legs ! Their antennae are quite short.

There are very few other Singers. Indeed the Crickets, which are relations of the Grasshoppers, are the only ones. One or two Beetles make a clicking sound by bending their bodies at a point where one ring scratches the next (for example the Death Watch Beetles) and a few other insects do the same. The larva of the Stag Beetle, and the Death's Head Moth (both as caterpillar and Moth) make creaking noises.

Bees, Flies, and flying Beetles make a buzzing with their wings, but this is no more a song than the purring of a motor engine. The various notes of a hive of Bees when excited or angry may perhaps be signals, but little is known of this either as to how the sounds are made or why. In any case they are not songs.

FOOD FOR OUR FOOD

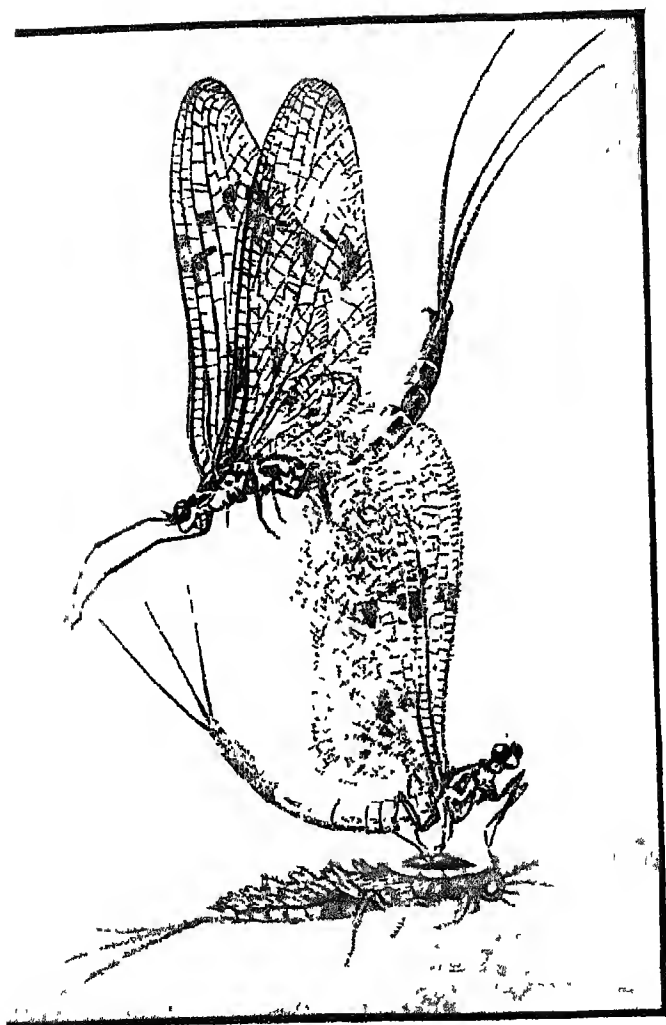
THERE are many Insects whose chief interest for us is the fact that they provide food for creatures that we eat. We ourselves, of course, do not eat insects, but we eat many creatures that do. Among the land animals we do not eat those which feed upon meat, except only the Pig and, the more carefully Pigs are fed for our tables, the more their food is chosen from vegetable materials. Of birds also we do not eat those that eat meat, such as the Crows and the Hawks. In the case of the other mainstay of our diet, the fishes, we eat them although they all feed upon other fish smaller than themselves.

Now, of the creatures that we do eat, there are two big groups that live largely upon Insects: the birds and the fresh water fishes. Poultry and game birds, although their chief food consists of grain and other plant seeds, eat a very large number of Insects. As there are no Insects in the sea, the sea fish do not eat them, but Insects make up a large part of the population of all fresh waters and therefore of the food of the fish that live in them.

The Mayfly is an example of an Insect that provides food for fresh-water fish, and is, for that reason, beloved by fishermen, who imitate it and its relatives by making artificial flies which look like them to deceive the fish.

The lives of these "fishing flies" are interesting in several ways. The mother Fly drops her eggs into the water, either one by one or in a packet which is dissolved when it gets wet, so that the eggs fall separately to the bottom of the water, and there hatch. The Mayfly larvae are rather like those of the Dragonflies in shape and, like them, are called Nymphs, but as they are not hunters but live on water weeds, they do not have the pincer jaws, like grappling irons, of the Dragonfly nymphs.

Under the water these larvae live, growing and moulting



MAYFLIES (x 2)
Nymph skin, Dun and Spinner

A Book of Common Insects

like all Insects, until they have reached their full size. This takes almost a full year. During this year many of them are eaten by fresh-water fish which take their meals among the weeds which the Nymphs are feeding.

Just a year from the time when the eggs were laid, the full grown nymphs rise to the top of the water, their skins split, and the winged Flies crawl out and take to the air. The whole process is very swift and takes only a second or two. The dimple caused by the break in the surface of the water when the nymph rises, floats a few inches down the stream, and the Mayfly rises from it into the air.

The Mayfly family are the only Insects which moult once more after they have wings. Their whole life as Flies is very short. Some live only a single day, and very few live more than two or three. Yet, during this short life, they shed a thin skin from the whole surface of their bodies, wings, and limbs. When they first take wing they are known as "duns" to the fishermen. Their wings are a dull greeny-brown and covered with hairs. After the moult they are called "spinners". Then their wings are clear and transparent, the tails which mark the whole family are still longer, and they are ready to mate, lay their eggs and die. In both these forms, they have no mouths, and they take no food of any kind once they have left the water. The fish take toll of the Mayflies at the moments when they are at the surface of the water. First when they are coming out of the larval skin (when they are said to be "rising") and later when the females dip down to the water to lay their eggs. So eager and greedy are Trout for the large Fishing Flies (to which alone the name Mayfly strictly applies), that after their season (which is usually in June) the Trout will scarcely trouble to look at the small ones until September.

Although it is as food for the fish that these Fishing Flies are chiefly famous, Bats, Martins, Swallows and countless other birds greedily snap them up. Also any of our domes-

Food for our Food

tic poultry which live near their streams.

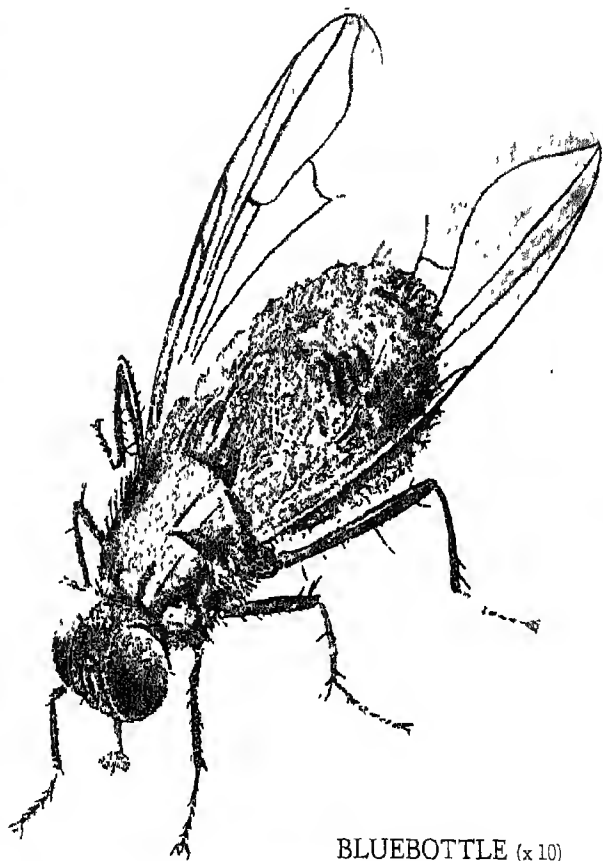
The Insects which provide food for our food, that is to say, for fish and fowl, are very numerous. Indeed it would be easier to make a list of the few Insects which escape being eaten by poultry or game birds, either as eggs, larvae, pupae, or adults, than to name those that are eaten. Tiny chicks and ducklings will snap at a fly, and catch it on the wing, almost as soon as they are hatched, and they will go on scratching the ground and nuzzling among weeds all their lives to get every kind of Insect.

In this way, although we do not ourselves eat Insects, they form an important part of what we do eat, in the form of the " Food of our Food ".

THE POISONERS

THE commonest of all Insects inside our houses are the Flies. They are of many kinds and they differ a good deal in their habits as well as in their appearance. Those which are, above all, Poisoners of our Food belong to the two families of Flies which include the common House Fly and the Bluebottles. The sketch opposite illustrates one of the smaller of the house haunting Bluebottles and gives an idea of the appearance of all these Insects. They have only two wings, the second pair being reduced to a pair of so called "balancers", about which we know little except that the Insect cannot fly without them. Flies go through a most complete set of changes after hatching from their eggs. The eggs hatch quickly. Indeed, some even hatch before the mother-fly has had time to lay them, so that the maggots are born alive. The eggs or maggots are placed by the mother on the food that they are to eat and they therefore have to make no effort beyond that of eating. This they do so quickly that in a very few days they are fully grown. Fly maggots (or "gentles" as they are called by fishermen) are among the simplest creatures known. They have no eyes, legs, or other organs, nothing except a mouth which is at the smaller end of a tube. The purpose of this is to absorb and digest the liquid from decaying animal or vegetable matter. From their mouths comes a saliva which reduces the meat or vegetable to a liquid so that they can suck it up.

When the maggots are fully grown they become pupae. This they do inside the last skin of the maggot which darkens and hardens into a stiff, leathery, shell ending in a lid at the head end. Within a short time, the newly formed Fly pushes open that lid and comes out with all its organs complete; eyes, trunk-like sucking mouth, antennae, wings, legs, and hairy body, all perfect. Here it is worth while to repeat what was said in the introduction. When once the



BLUEBOTTLE (x 10)

A Book of Common Insects

Fly is formed, it will never grow any larger. When you see tiny Flies they are not the young of bigger Flies. They are merely different kinds of Flies. The male and female Flies differ, so far as outward appearance goes, chiefly in the size of their eyes—those of the males being much the larger, often, indeed, so large as to touch each other and almost cover the whole head.

When you see Flies circling round and round a hanging lamp or chandelier—"weaving flies" as they have been aptly called—these are males, waiting in an eager dance for the chance of meeting a mate. The moment a female comes near, one of the dancers will leave the group and go off with her.

Adult Flies, like their maggots, live by sucking moisture, and they find it mainly on the surface of decaying vegetation, meat, dung, or any form of nastiness. They, like their maggots, have the habit of spitting out on to their food a substance which makes it become liquid. They also leave upon it black messes which contain the part of their food which they do not digest. Anything dirtied in this way is said to be "fly-blown", and when their food is also ours we run a great risk of being poisoned.

Now, these creatures have another taste which makes them a serious danger to us. They can make liquid, and then suck up, starch and sugar, and they are greedily fond of anything sweet or starchy. Thus they like almost all our food or drinks as well as all forms of filth and decay.

To lay their eggs they visit dust, dunghills, raw or decaying meat or fish, or rotting vegetables, while for their own food they crawl over bread, cakes, milk, or cooked meats, soiling everything they touch. Their spitting mouths and their dirty, hairy, feet and bodies carry all that filth and nastiness directly on to our food. In this way they are the most deadly of all carriers of disease to us and deserve the name of Food Poisoners.

The Poisoners

So you see why Flies should be ruthlessly destroyed by every possible means. They are the more dangerous because the harm that they do is slow. It may be many days before the food which they leave poisoned makes us ill. So that the damage they do is harder to trace to them than that of the Insects which bite or sting us. Swat that Fly !

Flies should be killed by fly-papers, traps and swatters. No Fly should ever be allowed to get at milk, butter, bread, meat, or any other food. If you see a Fly in the larder or any room where there is food, kill it at once. It is also important not to allow dust to collect, for it is in the dust, between floor-boards or behind picture rails or in such places, that the common House Flies lay their eggs.

The Stable Fly, which looks much like a House Fly and which we have noticed among the Blood-suckers, practises both these vile trades, and is therefore also to be dreaded, but, as it bites us, and calls our attention to it, its danger is less secret and treacherous than that of the Bluebottle and the House Fly. There are not as many Bluebottles as there are House Flies indoors as they usually come into our houses only if meat or fish is left uncovered where they can get at it to drop their maggots.

The number of Flies in summer is limited only by the food provided for them as in warm weather they go through all their stages in a month and each female lays a very large number of eggs. In cold weather their growth is held up so that they pass the winter in the form of eggs, maggots, or pupae, sleeping, motionless, in the dust.

THE GARDENERS

WE often speak about trees, bushes, vegetables, weeds, and flowers, as if the only plants which had flowers were those which we grow or gather for the beauty of their blossoms. It is not until we know more about them that we learn that almost all plants have flowers, from the great oak tree to the smallest weed, and that the tiniest and most unnoticeable of them often have great beauty. These blossoms hold the germs of the seeds from which another crop of the plants will grow. The blossoms also produce the minute grains of pollen, like yellow dust, which must reach those germs before the seed can ripen and be ready for sowing, or, as we say, before they become fertile.

Until the pollen is carried from one flower to the seed germs of another, we shall have no fruit, no vegetables, and no crops from the flower-bearing plants. Carrying the pollen to the seed-germs is done for some plants by the wind, but far the greater number need the help of gardeners.

If you think of the many tiny flower bells in a single head of clover, and of the number of clover heads in a single field, you will see that no human gardeners could ever do this work. And yet, if it were not done, not a seed would be ripened in the field for next year's sowing. Who, then, works for us all day, as the fairies are said to work while we sleep? The answer is simple :—the Gardener Insects, who are the fertilizers of the plant world.

If you watch a clover field in full flower, you will see a portly Bumble Bee busily bustling from blossom to blossom. Into each one of the tiny flowers she thrusts her long tongue to lick up the sweet liquid which we call nectar. Meanwhile her head and back become dusty with the pollen and her furry cap and tippet yellowed with the golden powder. Later you will see her scoop the pollen off her head and body into her big basket-shaped hind legs and, when fully loaded, fly



BUFF-TAILED BUMBLE BEE

QUEEN (x 4)

A Book of Common Insects

off to her nest. But before this she will have visited many blossoms and have left on all of them some of the fertilizing dust. Hard as she works you will see how many thousands of Bees are needed for even one clover field.

The Bee does not do this work knowing that it is necessary if a crop is to grow next year. She does it because she needs the nectar and pollen to feed herself and her young. She makes honey from the nectar, by a process rather like digestion, and, by a further digestion of some of it, she makes wax.

The Bumble Bee sleeps through the winter in an underground hole and does not wake until the first warm days of spring arouse her. Then she begins the business of founding a family. She looks for a suitable home, such as an old mouse-hole in the ground, which she lines with grass, or similar bedding, and digs out to the proper size. Then she goes to the flowers to get nectar and pollen and comes back to make the nectar into honey. When it is made, she mixes it and the pollen into a paste with which she builds a platform in the nest and on this she lays from six to a dozen eggs. Wax soon begins to ooze out between the rings of her body. With this wax, and using her legs and jaws as tools, she builds a cover over the nest-platform and also a pot the size of a thimble, which she fills with honey.

About a week later the first eggs hatch into grubs, which at once begin to feed on the paste of which their platform was built. Their mother renews it and a little cell is formed around each one in which they grow to their full size and become pupae in readiness for the change into full-grown Bumble Bees. It will be about a month after the first egg was laid before this happens and the mother will have laid many more eggs. All this time she has had to feed both herself and all her family by her own unaided efforts. She has been all alone. Her mate died soon after their marriage flight in the previous autumn, and she has had to dig, furnish, make honey and wax, mould the pots, lay the eggs, nurse, feed,

The Gardeners

clean and keep house, and all this time she has been the gardener and fertilizer of our crops.

When her first children are grown up, her life changes. Henceforth she stays in the nest and does nothing but lay eggs, leaving all the other duties to her daughters. They must feed her too, for she no longer goes out to the flowers.

All through the early summer the children hatched from her eggs are what are called "workers"—that is Bumble Bees smaller than herself, and unable to lay eggs. These workers know, without teaching, how to gather nectar and pollen, make honey and wax, and look after their mother and younger sisters, so that all the work of fertilizing the world of plants is handed over to them.

Late in the summer a crop of males and "queens" (which are big, egg-laying Bees, like the mother) is produced. The males die after their wedding flights, and the queens do not return to the nest but hide for the winter, and when the next spring comes each founds her own nest as her mother did before her. The old mother Queen and all the worker sisters die when the cold sets in.

A great number of insects belong to the guild of Gardeners and so deserve our gratitude—above all the Bumble Bee (we have over 30 kinds) and the domestic Honey-Bees. But there are also the other solitary Bees, the Wasps, the Sawflies, the Butterflies, many Moths, and a large number of Beetles and Flies. In short, every Insect you see on the flowers of the garden, or the blossoms of the trees, is a Gardener.

THE SPINNERS

THE Spider is not an Insect. It has eight legs instead of six and its body is divided into two, instead of three parts. It has two poison fangs with which it kills its prey and eight small single eyes and no large ones, and there are other differences. But, until you begin to think of yourself as an "Entomologist", you will think of a Spider as an Insect, and the Spider is so much the most wonderful of all the Spinners that here she is.

A large number of real, six-legged, Insects spin silk in the larval stage, and they do so from their mouths, pouring out, from a minute tube on the lower lip, a stream of two mixed liquids which harden, on exposure to the air, into the solid thread which we call silk. This is done by the larvae of all the Butterflies and Moths, and the silk serves them in very various ways. Thus it may build a platform on which to walk safely when they might slip off other surfaces, it may make a covering shelter to hide them from their enemies or protect them from the sun, or it may leave a thread to guide their fellows in the right path, or act as a guide-rope down which they can hastily slide to escape from an inquisitive Ant and up which they can climb again to regain the leaf from which they started. Above all (and this is the use to which the Silkworm puts her silk) it may make a soft protecting cover for the pupa during its tender and defenceless existence. Such silk covers are called cocoons, and the larvae of many Beetles, Ants, Bees, Wasps, and other Insects, have spinning organs and use them in this way. Some few larvae of the Caddis-Fly family even spin nets in, or over, the surface of the water in which they live to catch the tiny creatures which form their food. But no adult Insect spins.

Many of the Spiders, however (of which I have illustrated our largest and handsomest kind, the common Garden Spider) spin all through their lives and wherever they go.



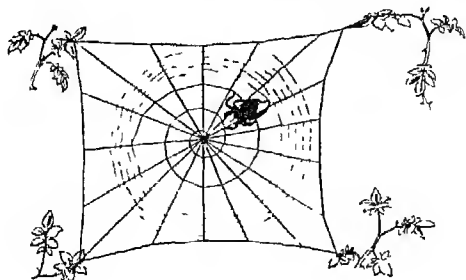
GARDEN SPIDER (x 3) Male above, life size

A Book of Common Insects

They have four spinning tubes which project backwards under their rounded, portly bellies, and from which different kinds of silk can be poured at will. Many spiders make cocoons to protect their eggs. Those like the Garden Spider use their silk in two ways wholly different from any of those already mentioned.

The first is that of a glider and parachute, and the silk is used in this way only once in the Spider's life, when it is very young. The young Spiders look just like their elders when they come out of the eggs, and as soon as they are ready to leave the protection of their mothers (which is usually in the early autumn), they climb to the top of the nearest tree, or a high object of any kind. There they let out a long thread of silk which floats loosely in the breeze and as it gets longer begins to pull the tiny Spider backwards. Then they let go of their hold and allow the air currents to take them wherever they may, upon the only long and adventurous journey of their lives. The thread is so long that their minute weight at the end is barely felt. When they fall to earth (it may be near or it may be many miles away), they settle down and begin to spin their famous webs, in which to catch the flying Insects which are their food.

Look carefully at the next perfect Spider's web you see, or, if you get the chance, watch a Spider making her web.



The Spinners

You will see her fasten a thread to a twig and then drop down it to the end and begin to climb up again, spinning as she goes, so as to leave a double thread hanging behind her when she gets back to her starting point. There she must wait for the wind to carry the thread across to a neighbouring bush, when that thread (pulled tight by her fore legs, and strengthened by repeated tightrope journeys back and forth) becomes the main cable from which the web will be hung. She first completes the frame, then builds in it a wheel with all its spokes, and a temporary spiral circling round the spokes to serve as a platform on which she can walk while spinning the real snare. Then she changes to a thinner quality of silk coated with the sticky liquid, like bird-lime, which will entangle any insect that touches it. With this she adds the final spiral going round the hub, from spoke to spoke, gradually working inwards and, thriftily, eating the temporary spiral as she goes, so as not to lose the silk. When the web is finished, she sits holding a thread from its centre at some convenient place from which she can rush in if a jerk tells her that some living thing is caught. If an Insect is caught, you will see her whirl it round and round after touching it with a line of silk, so that it is bound and its struggles are mastered before she uses her poison fangs to finish it off.

When Spiders are young they usually build a new web every day. In later life they are more sparing of silk and do not build so often. No Spider ever repairs a torn web : either it is left torn, or a new one is built.

One accusation is often brought against the female Spider. It is said that when tired of her husband she becomes a widow by the simple process of eating him. Perhaps this is not so usual as has been suggested, but it certainly has happened and the male Spider seems to think it possible to judge from the speed and agility with which he hurries out of her way.

THE DUSTMEN

WHEN we think of the numbers of cattle, sheep, horses, and other animals in our fields, we may often wonder how it is that the whole country is not soured and made unhealthy by their droppings. One reason for this is supplied by the Dor Beetles, which are among the commonest and most hard-working of nature's Dustmen. Wherever droppings have fallen upon the ground, towards evening a whirring and buzzing will be heard and a deep blue-black Beetle, of the size of a Bumble Bee, will come flying to the spot and will, somewhat clumsily, settle down close to it and begin to work at the business of burying the mass.

The Beetle works fast, steadily, and without a rest. A hole is dug, straight down into the ground under the mass of dung, to a depth of a foot or more. From this hole, armful by armful, the earth is brought out to the surface and replaced by some of the cow-pat from above. This provides a rich store of food for the Insect, in a quiet and perfectly protected hiding-place where it can be enjoyed without disturbance. The quantity buried in a single night (for it is at dusk that the Beetles begin to work) is far greater than their needs. Often by the morning the whole mass will have disappeared, and the owner of so much wealth will settle down for the day to rest and feed in peace. Yet, although it will have eaten very little from its store of food, the next evening the Beetle will be on the surface and alert, waving its sensitive five-fingered antennae to catch the scent of another windfall, to which it will fly, to begin its useful work again. In this way the fields are not only kept clean, but also manured because the richest of fertilizers is being dug in to the exact spot where the roots of the grass most need it.

These Dor Beetles, Clocks, or Dumble Dors, as they are also called, are very remarkable in their lives. In the first place they are among the very few Insects which enjoy quite



life size



DOR BEETLE
(x 3)

A Book of Common Insects

a long life after they have become fully grown and have entered upon the winged, adult stage. They live several years as Beetles so they may be seen at work alongside their children and grand-children. Very few Insects ever see their young fully grown, and many never see them even as grubs.

Secondly, they are the only known Insect among whom the males help their wives to make provision for the children. When the time comes (in the autumn) for the females to lay their eggs, husband and wife work together at the burrowing of the nest holes and the burying of the supplies upon which the eggs are laid, each one in a separate well-stocked tunnel. The work is hard, for there are many nests to be dug, and the food for these nurseries has to be chosen and chewed by the mother and hardened on its outside with saliva from her mouth so as to keep out the winter rains and remain in good condition for the larva for nearly a year. Yet the father helps his mate to the end. When the nurseries have all been provisioned and the eggs laid, the parents fly off to find another supply of food. They dig themselves deeper tunnels, fill them with provisions, and there spend the winter months.

The larvae hatch out in about a fortnight, unless their development is stopped by the cold of winter, and, being so richly provided with food, they soon reach full growth. They do not, however, come to the surface of the ground until about September in the following year. Then they begin to practise their useful trade.

I have already, under the name of the Grave Diggers, spoken of one group of Insects which help in cleaning our world of its refuse, but in this good work there are a very large number of other helpers. There are many things which, without their help, would soon become a danger. This is true of all dead plants and animals. These things must be eaten or destroyed so that they cannot breed disease. All of them are the special food of some Insect, and when they are

The Dustmen

dug into the ground they make the soil rich and feed the growing plants.

There are Beetle grubs and Fly maggots which feed wholly upon dead animals, birds or fishes, and they do their work so quickly that one of the greatest of naturalists (the Swede named Linnaeus, who lived in the XVIIIth century) said that the children of one pair of flies would eat up a dead horse more swiftly than a lion would. Some Insects eat up the leather, hair, and even the bones of dead animals. These are chiefly the grubs of Beetles or Moths. Decaying vegetation is the favourite food of many of the Fly maggots. The Ants do a certain amount of Dustman's work. They eat up anything, animal or vegetable, which has become liquid. There is also a family of very small Insects, called Bristle-tails, which are so useful in eating filth in our sewage farms that they deserve special mention among the Dustmen.

This seems such a nasty business that our first feeling is one of disgust, but we must not forget how useful these Dustmen are, or how much dirtier the world would be without them.

THE INSECT HUNTERS

IF we ask ourselves whether Insects are, on the whole, useful or harmful to Man, we shall find that we have already answered the question, because we have never doubted for an instant that any insect-eating bird is a friend deserving our gratitude and protection. In the same way, we owe a debt to such Insects as gain their living by eating other Insects. Luckily for us there is constant civil war between the Insects, and there is no doubt that, if this were not so, Man, and all the land animals of the world, would soon be starved by those Insects which are here called the Food-destroyers.

As an example of an Insect Hunter I will choose the small ruby red Dragonfly called the Damsel Fly. All the Dragonflies are Insect Hunters throughout their lives, but these beautiful little Damsel Flies have a further claim upon our interest which we shall see when we speak of their married life.

The Damsel Flies lay their eggs on water weeds, under the surface of running or still water. You may see them by the bank of any stream, pond or canal. The eggs remain under the water and soon hatch into larvae. These look like straight shrimps. One is illustrated at the bottom of the sketch opposite. You should notice the odd shape of this creature's mouth. The lower jaw is formed as a powerful pair of pincers, gripping sideways, and is thrown out forwards so as to grasp its prey some distance ahead of the larva. When not in use, this pair of tongs lies folded back under the chin, and when in use it shoots forward swiftly to catch the victim and drag it back to the mouth. Their prey consists wholly of small living creatures found in the water, and mainly of insect larvae, such as those of water Beetles and Gnats.

These Dragonfly larvae (or Nymphs, as they are also called) only make one important change in their lives. When they are fully grown, perhaps after nearly a year in the water,



DAMSEL FLIES

Pair laying eggs and nymph (x 2) Pair behind, life size

A Book of Common Insects

they crawl out on to some weed. Their skin splits at the back, and the fully grown Damsel Fly crawls carefully out of the old skin. At first it is soft and colourless, but it soon hardens and flies off to find a mate. They differ much in colour, but the ruby-red kind, here pictured, is one of the commonest.

The most interesting thing about this insect is that the males help their wives in the difficult business of laying the eggs under water. To do this the female is obliged to go below the surface, or, at least, to put her long body into the water to reach the underside of a water-weed leaf, and, in so doing, she would run a great risk of being unable to get out again. So the husband helps in the work. He has a pair of pincers at the end of his long tail. With these, he grips his wife by the scruff of the neck so that they can fly together—he ahead and she behind—looking like one long dragonfly with eight wings, four in front, and four in the middle. In this way, like two horses harnessed in tandem, they fly about until a suitable weed is found. Then the female drops down to it. The male either takes hold of the upper part of the weed (as in my sketch) or, if that is not convenient, he just stays poised in the air, stiffly standing, as it were, on his tail above her, with his wings laid back over his body. In both cases he firmly keeps his hold upon her until the eggs are laid.

Some Damsel Flies even crawl wholly under the water. When the eggs are laid, the male flies up, and hauls his wife up and away to safety in the air, where, still in tandem, they fly on to find another suitable weed on which another batch of eggs can be laid.

This help by the male in egg laying is most unusual among Insects. A few of the Beetles do something like it. As a general rule, however, the Insect males are utterly without interest in their families.

As I have said, there are a vast number of Insect-hunting Insects. The Ants kill Insects and suck their blood and

The Insect Hunters

the Wasps kill them for their young, though they drink nectar as adults. Many of the two-winged Flies are hunters of other Insects and a large number of Beetles and Bugs do the same. So do the Long-horned Grasshoppers, the Lace-wings, several Butterfly and Moth caterpillars, and many others.

There is, however, one large body of Insects which deserves to be mentioned because of the special way in which they attack their Insect prey. These are usually called the Ichneumons, or Ichneumon Flies. As adults, these do not eat Insects, but they hunt them relentlessly and lay their eggs on, or in, their victims. Sometimes the eggs are laid on the eggs, sometimes on the larvae, sometimes on the pupa, and sometimes on the full grown Insect. Sometimes they are laid inside the victim, but in any case the result is the same. The Ichneumon-grub hatches and lives on the blood of the victim, which is also allowed to live until just before the invader is fully grown and ready to fly. Then the Ichneumon flies off, leaving the dead body of its victim, and soon begins the hunt for another in which to lay her own eggs. These creatures belong to various families, some of which are two-winged Flies, while the greater number are relations of the Bees and Wasps. Their numbers are, fortunately, very great, for they are our most valuable defence against some of the greatest of our enemies—the plant-eating Insects.

THE SERVANT OF MAN

THERE are many beasts and birds which we keep so that they may serve us. And we protect them against their enemies and supply them with food and shelter in return. We call them domestic animals and poultry. Most of them supply us either with food or clothing. There are only two Insects which are the servants of man in this same way. These are the Silkworm Moth (which helps to clothe us) and the Honey-Bee. The Silkworm needs a climate warmer than ours, so that here we have only the Bee to represent the domestic Insects.

In return for what we do for them, the Bees give us honey and wax. They make these in their own bodies from the sweet liquid (called nectar) which they suck from flowers. Although honey and wax are still useful, they are not as important as they once were. Electric light has largely taken the place of candles, which are now often made of oils instead of wax. When men first kept Bees there was no sugar, and honey was the only thing with which food could be sweetened. Sugar cane and, later, sugar-beet, have changed honey from a necessity into a luxury. But though Bees are less important in this way, we now know how important they are as fertilizers of plants. This was explained in the section on the Gardeners (page 54). No Gardeners are as numerous, or as useful, as the Hive or Honey-Bees.

The Honey-Bee's life is like that of the Bumble Bee in many ways. It also lives in communities. It also produces a large number of "workers", or smaller females, which do not lay eggs, but do all the work of the hive. They build the comb of wax, fill a part of it with stored honey and pollen, feed the young brood in the larva stage, and help them out of their skins when they become full grown Bees.

The chief difference between the Honey-Bees and the Bumbles is that the Honey-Bees' communities are much larger



WORKER BEE (v 5) Above, Queen, Worker and Drone, life size

A Book of Common Insects

and are permanent. The mother Bee (or Queen) lives for several years and many of the workers live through the winter, whereas among the Bumbles the whole community dies off, leaving only young queens to found new communities in the coming year. The reason the whole hive survives is that the Bees store sufficient quantities of honey in waxen honeycomb to carry the workers and their queen through the winter months.

Only one breeding queen is alive in the hive at a time and she tries to kill any young females (or "princesses"), who might become her rivals. When Bees want to found a new colony they "swarm". That means that when a hive is prosperous, well stocked with honey, and sufficiently numerous for a new colony to be started, the old queen's escort of workers will keep her away from the nurseries where the young princesses are growing up so that she cannot kill them, and, usually about May, she will take flight from the hive, with a large swarm of her worker daughters, and settle (surrounded by the workers in a solid, protecting clump) on some neighbouring tree. There they wait while a body of worker scouts look for a suitable hole in which the new nest can be made.

Before the scouts come back Man steps in. He captures the whole clump of Bees in a vessel called a "skip" and empties it into a hive. This hive is a sort of wooden doll's house built like a chest of drawers. To make it suit the Bees, some stamped bees-wax sheets are put in it as a beginning of the new comb, so that the Bees may think that work has already been started upon it. At least, even if they are not deceived, they are persuaded that the place is suitable, and they settle down in their new home.

Meanwhile in the old hive (still fairly full of Bees) one of the recently born princesses comes out of the cell (in which she has passed through her pupa stage) and she is allowed to kill, with her sting, all her rival sisters. Soon after this she

The Servant of Man

takes her wedding flight to mate with a male Bee, or "drone". On her return to the hive she is provided with an escort of workers who lead her round the brood cells to lay an egg in each. From that time until she leads off a swarm in the following year, egg laying is her only duty. She is fed, cleansed, and waited on by workers all her life, and when she becomes old or is to swarm, and new queens are wanted to succeed her, princesses are specially fed with royal food, and protected from her jealousy by her escort.

While there is only one Queen in the hive, there are a great many males, or "drones" as they are called. They are big-eyed, stingless, heavy-looking fellows, who feed from the honey stores in the hive and fly for a few hours only on sunny days for their own pleasure. They do no work, gather no nectar for the hive, and make no honey or wax. After the return of the Queen from her wedding flight, all the drones are refused admittance to the hive, and they all die of cold and starvation within a few days.

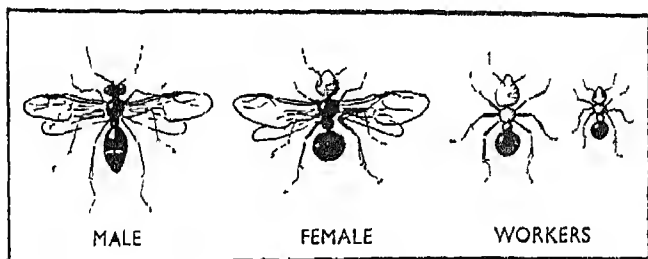
Although Man has kept Bees and used their honey for many hundreds of years, it is only recently that he has learned how to get the honey without the risk of killing all the bees in the hive. Until the idea of making the hive in the form of a chest of drawers enabled him to draw out the honeycomb while the Bees slept, the only way to get the accumulated store was by smoking the hive until the Bees were so suffocated that they were not able to resist the theft. This meant that many, and often all, the Bees had to be killed. Since the new way was discovered, the Bees have been encouraged to live on and to keep such honey as they need for the winter while we take away the rest.

THE HERDSMEN

MANY of us think of Ants as soon as we hear the word Insect. They seem to be all that we expect of an insect - small, creeping, hard-skinned things which tickle when they touch us and we have to beware of sitting down on their nests.

The Ants are relations of the Bees and Wasps, but the shape of their bodies differs. An Ant has two narrow waists, while the Bees or Wasps have, at most, only one waist.

Ants are social insects and, like the others (Wasps and Bees), live in large communities and produce not only males and females but also "workers". Among the Ants there are often several different types of workers in the same nest, fitted to do different jobs. Thus, among the Wood Ants, there are large workers with powerful jaws, who fight, and others, barely half their size, who forage and feed the whole nest.



These Wood Ants are those whose large ant-hills, crowned with a dome of pine-needles, are found in our woods. They are our largest Ants, the males and females being almost half an inch long. Their communities or "nests" may contain as many as 100,000 Ants, all of which are workers, except one or two hundred males and females.

Unlike other social insects the worker Ants have no wings. The males and females have four wings, just as a Wasp has,

The Herdsmen

and when these leave the nest together in vast numbers for their wedding flights you do see many winged Ants. If you watch these winged Ants settling after their flight, you will see a curious thing. The females, having flown only once in their lives, tear off their own wings at the shoulder and run off to find an ant's nest. Any nest of the same kind of Ant will gladly let a female enter (though usually strange Ants are killed at the doors) for she is welcome as adding to the mothers of the nest. If the now wingless female does not find a nest of her own kind of Ant, she will found a colony as a Bumble Bee does. She will build her nest, lay her eggs, and feed and bring up her brood of young workers alone until they are able to take over the work from her.

Ants make neither honey nor wax. The only store of food in an Ant's nest are in the stomachs of the Ants. Their nests are not built of wax or paper, but are tunnelled out of the ground and built up of sticks or stones held together with the saliva of the workers. If you see an Ant hauling a grain of wheat towards the nest, it is not for food but for building material. Ants do not eat dry grains or wheat. They suck up liquid food, using their powerful jaws to prepare their food by bruising and biting it until it is liquid. They also use their jaws to lift, carry, build and fight. They will eat anything, animal or vegetable, which is liquid or can be made so by their saliva.

It is because of the way in which they get the greater part of their food that I have called them Herdsmen in this book, and their cattle are Green-Fly, or Aphids.

These are the tiny green insects which swarm in thousands on almost all kinds of plants. Often our gardens are so full of Green-Fly that our flowers wither and droop. These Green-Fly belong to the Bugs, because they have sharp sucking beaks with which they suck the sap of the plants. Almost every plant has its own kind of Aphid and they multiply more quickly than any other visible creature. These

A Book of Common Insects

Green-Fly discharge, from tubes in their backs, a sweet sticky liquid (which we call honey dew) and which is the favourite food of the Ants.

If you watch an Ant when she meets a Green-Fly, you will see that she does not kill and eat it. She stands behind it and, after tickling it with her antennae, she licks its tubes dry of the honey dew, and then leaves it in peace and goes her way to another Aphid to do the same. This "milking" of the Green-Fly is the main business of the worker Ants outside the nest. It is in this way that they collect food for the nest. They will kill, tear to pieces, and suck dry any other creature they can master, and eat any animal or vegetable food which provides moisture, but their chief source of food comes from milking their herds of Aphids.

When I speak of their "herds" I do not merely mean that if they meet the Green-Fly they milk it. The Ants do much more than this. Each ants' nest has a well defined district—it may be half a great oak-tree—which is their private pasture ground for Green-Fly. Any Ants from a rival nest, and any other Insect, or even a bird, poaching on this territory, will be fiercely attacked by the soldiers of the nest and driven off.

Thus, just as we preserve pastures for our cattle and protect them, so do the Ants protect and herd their tiny green cattle.

This liquid-sucking by the worker Ants is not only for their own good. It is for the good of the whole nest. To explain this we have to know what the microscope shows when we look through it at the inside of the Ant. The worker Ant has two stomachs. The first of these receives all that she swallows, and its contents are not hers at all, but are the property of the nest. When she sucks up food it goes into that public (or community) stomach and is at the service of every other Ant and larva in the nest. Any one of her sisters has only to signal that she is hungry for food to be passed to her, from tongue to tongue, from that first stomach. Such

The Herdsmen

food as an Ant needs for herself she can pass on to the second stomach, which is her own, for digestion. This system may be clearer if you will think of each Ant as being a petrol lorry which has two separate tanks, one big tank which supplies other vehicles, and one small tank for its own engine. The smooth working of the communal life of the anthill depends upon the Ants having these community stomachs. If an Ant is greedy, it is to fill the public stomach, not her own.

The young Ants are not brought up in separate cells, like the Bees, but a great many together, in nurseries according to their ages. The newly laid eggs are carried to one chamber in the nest, and, as the larvae grow up, they are moved to others, damper, dryer, warmer or cooler, according to their needs, or to changes in the weather. In winter the nest is dug down deeper into the ground to avoid the cold, and its population sleeps until spring. The small white objects, usually called "ants' eggs", which you will see the Ants hurriedly moving to safety if you disturb the nest, are not the eggs, but the pupae in their cocoons.

Some Ants invade the nests of others and capture their pupae which they take home and bring up to be their slaves and work for them.

There are Ants which have stings, but most of our Ants have only the poison sacs and they squirt acid in the face of an enemy in an explosion of vapour. This is irritating to our eyes and, if the Ants also bite us, the acid makes the bite painful.

CLASSIFICATION

BEFORE closing this little book, I wish to give some idea of the way in which the Insects are divided by those who study them seriously

You will have seen that these chapter headings have been taken from the habits of the various Insects as they affect us, or from such things as we notice about them. This method does not divide them into separate groups, because the same Insect often appears in several chapters; Insects very different in form appear in the same chapter, and Insects very much alike appear in different chapters.

Now, to get a division which gives any idea of the relationship between the different Insects, and which keeps them apart, each in its own group, they must be divided according to their form, or anatomy. So the scientific classification of Insects is based upon the form of the adult Insect (chiefly its mouth and its wings) and its development during childhood.

Five of the large groups, or Orders as they are called, into which the Insects are divided are easy to recognise and are as follows :—

The BEETLES (*Coleoptera*) are Insects of which the fore wings form hard cases that cover the hind wings which, alone, are used in flight. They have chewing mouths, both as grubs and as adults.

The BUTTERFLIES and MOTHS (*Lepidoptera*) have four flying wings and both their wings and their bodies are covered with minute scales, the colour patterns of which give these Insects their beauty. Their grubs (or caterpillars) have chewing mouths, while the adults have only tubes for sucking liquids.

The ANTS, BEES, WASPS, etc. (*Hymenoptera*) have four transparent wings of which the fore wings are the larger. The wings have few veins, and this Order includes all our social Insects. Their grubs have either chewing or sucking mouths, and the adults have both chewing jaws and tongues for licking liquids.

The FLIES (*Diptera*) have only a single pair of wings

Classification

These are the fore wings and are transparent. Their grubs (maggots) have chewing or sucking mouths and the adults have sucking mouths, sometimes also provided with piercing needles.

All the above Insects go through a series of dramatic changes in their youth, passing through the different stages of egg, grub, pupa, and adult.

The BUGS (*Hemiptera*) change little throughout their lives. Their mouths are formed into stiff piercing and sucking tubes (held pointing backwards under their bodies when not in use) with which they drill through the skin of the plants or animals on which they feed. They have four wings of which the fore pair are usually partly leathery, the hind pair being transparent. Among these five Orders are far the greater number of our Insects. There are more than 3,000 kinds of Beetles, more than 2,000 Moths, nearly 2,000 Ants, Bees, etc., about 3,000 true Flies, and over a thousand different kinds of Bugs.

The classification of the remaining Insects is much more difficult and the authorities differ much about it, so that no attempt to explain it is possible in a book of this kind. Almost all of them have four flying wings with a great number of veins in them and, for that reason, most of them were classed together at one time under the name of "Vein-wings" (*Neuroptera*). Some of these (the Grasshoppers, Cockroaches, Mayflies, and Dragonflies) have already been described, and others are the Earwigs, Stoneflies, Alders, Lacewings, Scorpion Flies, and Caddis-Flies.

In all Orders of Insects there are a few kinds which have no wings at all, and the Fleas are believed to be descendants of two-winged Flies, which have lost their wings owing to disuse.

A few primitive Insects are completely wingless and almost unchanged throughout their lives. Such are the Springtails and Bristle-tails of which the commonest are the creatures often seen in our kitchens and known as "Silver Fish."

You must remember that the Spiders, Centipedes, and Woodlice are not strictly Insects in the scientific sense of the word because they have more than six walking legs. But they are usually called Insects.

INDEX

Ant - - -	74, 41, 65	Gnat - - -	22
Bee, Bumble - -	54, 37	Green-Fly - - -	17, 75
„ Hive or Honey	70, 37, 57	Grasshoppers - -	42
Beetle, Bombardier -	41	Hemiptera, Bugs - -	79
„ Death Watch -	13, 45	Horntails - - -	13
„ Diver or Water -	30	Hymenoptera, Wasps, etc,	78
„ Dor - - -	62	Ichneumons - - -	69
„ Sexton - - -	18	Ladybird - - -	12, 29
„ Stag - - -	10, 45	Lepidoptera, Moths, etc	78
Bristle-tails - -	65, 79	Mayfly - - -	46
Bug, Bed - - -	25, 41	Midge - - -	25
„ Plant - - -	17	Moths - - -	17, 29
„ Water - - -	33	„ Clear Wing - -	13
Butterfly, Fritillary -	29	„ Death's Head -	45
„ Large White -	14	„ Goat - - -	13
„ Orange Tip -	29	„ Silkworm - - -	70
„ Red Admiral -	26	Sawflies - - -	17
Cockroach - - -	38	Sexton Beetles - -	18
Coleoptera, Beetles -	78	Silver Fish - - -	79
Cricket- - - -	45	Spider, Garden - -	58
Damsel Flies- - -	66	„ Water - - -	33
Diptera, True Flies -	78	Wasp - - -	34
Divers - - -	30	Water Beetle - - -	30
Dragonflies - - -	66, 29		
Fleas - - -	79		
Fly, House - - -	50		
„ Stable - - -	25, 53		

